that the moistening process, as outlined, is performed, as a rule, during the flight from flower to flower. Indeed, upon reflection, one feels convinced that this would be the most convenient interval in the ceaseless work of the proverbially busy bee for performing this function, while at the same time the instinct to do it then, once acquired, would ensure its accomplishment when and as often as necessary. I intend to dust with flour the hind metatarsi of bees entering flowers, and also those of bees leaving flowers. If the former retain more flour than the latter, the theory that the moistening takes place during the flight from flower to flower will be demonstrated.

Probably the kinematograph will be able before long to reproduce the whole process of pollen-collecting at a speed slow enough to be followed by the human eye.

Ripple, Dover. F. W. L. SLADEN.

Microscope Stands.

MR. J. W. OGILVY, in his reply (NATURE, February 8) to one of my questions, does little more than reiterate his former statement that the German instruments are superior, and are produced in better organised works. This seems to introduce the question of workmanship, which has not, to my knowledge, been brought under consideration. The discussion seems to be one of design.

Mr. Ogilvy also appeals for proof of superiority to the number of Continental instruments in the various technical laboratories. Even if the number in use is larger, this cannot be accepted as proof of their superiority. The number of chromatic "Abbe" condensers must be much larger than of other condensers, but this does not prove that it is the best condenser. I do not think it has been proved that the most intelligent users are to be found in the various technical laboratories. The last paragraph of "F.R.M.S.'s" letter is proof of what I mean.

Now, with regard to the sprung fittings, Mr. E. M. Nelson, writing in the current issue of *The English Mechanic*, says:—"I have always considered springing to be a most important point in microscope construction."

The question seems to be this: "Which instrument, the English or the Continental, is, by virtue of its design and workmanship combined, capable of affording the scientific worker the greatest facilities for work of a critical character?"

I venture to think that the answer to this question by our most eminent workers would not be so much in favour of the Continental type as Mr. Ogilvy seems to imagine.

Boston Spa, near Leeds. JOHN A. L. SUTCLIFFE.

As the writer of a letter on "Microscope Stands" in NATURE of February 22, I wish to add that the term "Continental firm" used in connection with the remarks on horseshoe base with extended rear toe, mechanical stage on a rotating principle, and machined slide bearings should include the American manufacturer.

F. R. BRAND.

Meteor-showers.

THE following meteor-showers become due in March; their arrangement is according to the principal maxima:—

Epoch March 1, 12h. (G.M.T.), fifth order of magnitude. Principal maximum, March 2, 13h. 5m.; secondary maximum, March 1, 9h. 30m.

Epoch March 5, 20h. 30m., eighteenth order of magnitude. Principal maximum, March 4, 12h. 35m.; secondary maxima, March 4, 9h. 30m. and 19h. 35m.

Epoch March 5, 21h., twenty-fifth order of magnitude. Principal maximum, March 6, 7h.; secondary maximum, March 5, 0h. 30m.

Epoch March 9, 22h. 30m., twenty-second order of magnitude. Principal maximum, March 8, 20h. 45m.; secondary maximum, March 8, 3h. 30m.

Epoch March 9, 3h. 30m., ninth order of magnitude. Principal maximum, March 9, 19h. 50m.; secondary maximum, March 9, 20h. 40m.

Epoch March 11, 8h. 30m., first order of magnitude. Principal maximum, March 10, 23h. 10m.; secondary maxima, March 10, 0h. 5m. and 16h. 50m.

Epoch March 12, 13h., ninth order of magnitude. Principal maximum, March 12, 12h. 50m.; secondary maximum, March 11, 13h. 40m.

Epoch March 13, 16h., twentieth order of magnitude. Principal maximum, March 13, 1h.; secondary maximum, March 12, 8h. 50m.

Epoch March 19, 22h., tenth order of magnitude. Principal maximum, March 18, 17h. 45m.; secondary maximum, March 18, 9h. 10m.

Epoch March 21, 10h., eighteenth order of magnitude. Principal maximum, March 19, 14h. 30m.; secondary maxima, March 17, 19h. 25m., and March 18, 4h. 30m.

Epoch March 19, 2h., approximately second order of magnitude. Principal maximum, March 20, 15h.; secondary maxima, March 19, 6h. 50m., and March 22, 10h. 50m.

Epoch March 22, 2h. 30m., tenth order of magnitude. Principal maximum, March 22, 3h. 20m.; secondary maxima, March 23, 16h. 25m. and 22h. 45m.

Epoch March 23, 21h., thirtieth order of magnitude. Principal maximum, March 24, 17h. 30m.; secondary maximum, March 26, 12h. 55m.

Epoch March 26, 14h., eighteenth order of magnitude. Principal maximum, March 26, 5h. 40m.; secondary maxima, March 26, 2h. 20m. and 11h. 30m.

Epoch March 27, 14h. 30m., twentieth order of magnitude. Principal maximum, March 27, 10h.; secondary maximum, March 27, 4h.

Epoch March 27, 4h. 30m., approximately first order of magnitude. Principal maximum, March 28, 22h. 45m.; secondary maxima, March 27, 12h. 10m., and March 28, 6h.

Though meteor-displays are distributed, apparently, pretty evenly over the month, yet there are periods of special intensity. These periods, which are four in number, comprise the dates March 2–4, March 9–13, March 20–22, and March 26–28. Heavy meteor-falls are due on the nights of March 2 and 4.

Dublin. JOHN R. HENRY.

EXAMINATIONS IN SECONDARY SCHOOLS.[1]

THE Consultative Committee of the Board of Education has, for the second time, made a report on examinations in secondary schools, and, though opinions may differ as to the precise value of the recommendations which the committee now makes, everyone must congratulate the members on the valuable information they have collected and the clearness with which they have shown once more the existence of a great evil, and the arguments for and against various methods of dealing with it. The report which the committee made seven years ago has been followed by a small improvement, but secondary education in this country still groans under the burden of a needlessly complicated system of examinations, which are the cause of the gravest injury, not only to secondary schools, but to all branches of higher education which depend so largely on the foundation laid in these schools.

One of the saddest points brought out in the report is the extent to which young children are at present submitted for examinations, notwithstanding the efforts of the Board of Education and certain local education authorities to prevent this. Thus a return supplied by the Lancashire Education Committee shows that nearly half of 1070 pupils of certain schools in the county submitted for external examinations during a given year were below the age of sixteen. Unfortunately, the ancient Universities of Oxford and Cambridge are amongst the greatest offenders in the matter of providing such examinations, for it appears that in their local examinations alone more than 20,000 children under sixteen were examined in 1908.

It is shown that the results of these examinations are largely used, more particularly by inferior schools, as a means of advertisement, and that this system is aided by the ancient universities by an arrangement by which, in their preliminary examinations, children under fourteen years of age can gain "distinctions" in individual subjects! As Mr. Paton, the high-master of the Manchester Grammar School, points out, "the endorsement of a certificate with the name of a university of national repute raises quite a false assumption of academic attainment."

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[1] Report of the Consultative Committee of the Board of Education on Examinations in Secondary Schools. Cd. 6004. (Wyman and Sons.) Price 2*s*. 6*d*.

Unfortunately, examinations of this kind for which a large number of candidates submit themselves are paying concerns; they are not only a source of income to the examiners employed, but the bodies which conduct them also make a considerable annual profit.

The report proves conclusively that the examinations as at present conducted are a source of at least as much (probably more) harm than good. The influence of these external examinations on the school curriculum is often distinctly bad; bookish subjects which can be easily examined get more credit than subjects of importance, such as handicraft for boys and cookery for girls, which are not readily brought into the examination net.

Not only is the curriculum damaged, but the teaching is also injured, and experiments are made difficult. If it is asked: "Why, then, do not the best teachers decline to prepare for these examinations?" the answer is that too many parents gauge the success of a school by its examination results, that many boys and girls must pass these examinations in order to qualify for the work they mean to undertake on leaving school, and that, if the schools declined to prepare for them, it would simply result in the children being forced to go to a "crammer," and so to lose such benefits as the examination system still allows the secondary schools to offer.

The subjects on the modern side of a school suffer more particularly, since existing schemes of examination tend to lessen the importance of a good knowledge of modern languages and of practical work in science. Instances are by no means uncommon when a teacher of science, in the interest of pupils who must pass a certain examination, is obliged to let them spend the time which ought to be devoted to practical work in "reading up" for the written examination. In but very few examinations is any credit given for the practical work done throughout the session. Even when a practical examination is held, it is of little use, since it can only test to a very small extent the examinee's aptitude for practical work and his understanding of the results which he obtains.

In literary subjects also the influence of the present examination system is often bad. A teacher cannot adopt what he considers the best methods, but must always have an eye to the kind of questions which the examiner, who is seldom in touch with him, is likely to set.

While the Universities of Oxford and Cambridge are probably mainly responsible for the present vicious system, it must be remembered that, as the committee points out, their objects were, and no doubt still are, undoubtedly good. They started these examinations at a time when the secondary schools of the country sadly needed guidance, both as to what should be taught and as to the standard of knowledge which their pupils ought to attain.

The modern universities are by no means blameless in the matter. With the exception of the northern universities, which have, fortunately, been compelled to adopt a common matriculation examination, each new university has taken its own view as to what its requirements for entry should be. It is true that they have adopted systems of "equivalents," but in no two cases are these "equivalents" alike, so that a boy or a girl who goes to school, say, in Birmingham, and whose parents move to London or Manchester at the age when the child is fit to enter a university, may very well find that, while the child is qualified for entry to the University at Birmingham, he cannot be admitted either at Manchester or in London without a further examination. Surely the time has come when, as in other civilised countries, there should be a school certificate which all the universities should be compelled to accept as qualifying for admission to their courses for a first degree.

But when the schools have provided for the requirements of the universities, they have only dealt with a small proportion of their pupils. The various professional bodies have various requirements for the admission of students. These are not always the same as those required by the universities; thus the Institution of Civil Engineers lays down conditions which can but rarely be fulfilled by boys who have attended schools where the training is mainly of a literary character; for the intending student must have passed his qualifying examination in more advanced mathematics and science. Why should a boy with distinct mathematical and engineering ability be shut out simply because his father has happened to send him to a classical school? By all means require him to give evidence in later examinations that he has the requisite amount of mathematical and scientific knowledge to enable him to become a competent engineer, but why block his way at entrance? The question ought not to be at this stage what the boy has learnt, but whether he has learnt it well, and whether his mind has been trained to be receptive of fresh knowledge.

Then, in addition to the requirements of the universities and professional bodies, we have the paradise of crammers provided by the Civil Service examinations. No doubt for many branches of the Civil Service special examinations are necessary, but for all except certain subordinate posts a certificate of the satisfactory completion of a secondary course should be regarded as an essential qualification. This is the case in Germany, though the Abiturienten Examen represents a longer period of training in a secondary school and a higher standard of attainment than the school certificate which the committee advocates.

If such a preliminary qualification were accepted, it would only be necessary for the Civil Service Commissioners to hold examinations in certain special subjects required by the various public departments.

The most important recommendations made by the committee are:—(1) in regard to a secondary-school certificate; (2) in regard to a secondary-school testamur; and (3) in regard to an examinations council to whom would be entrusted powers to carry into practice the principles which the committee favours.

The secondary-school certificate is to be issued to pupils not less than sixteen years of age; it is to be of approximately the same standard as the present matriculation examination, but is to be awarded not merely on written work, but partly on inspection, on an examination of the whole of the work done by the pupils, and on the marks given for such work by the teachers, who would have a consultative voice in the award of the certificate. This proposal involves a great improvement on the present chaotic system; but it represents only a step in the right direction.

It is unfortunate that in this country the majority of the pupils in secondary schools leave at about the age of sixteen or earlier, while in both Germany and America a far larger proportion remain at school until about the age of eighteen. For from this results a further drawback that, while the usual age of admission to German and American universities and technical high schools is not less than eighteen, the modern universities in this country and the technical colleges are obliged to fix their minimum age of admission at sixteen, and so to do in the early part of their courses work which might very well be left to the secondary schools. It is, therefore, desirable that the age for the award of the secondary-school certificate should be gradually raised to eighteen, as Great Britain slowly awakes to the need of education, in order to enable us to compete on equal terms with foreigners. But at present this would be a useless counsel of perfection.

The secondary-school testamur is to be given to pupils of about the age of fifteen, and the committee suggests that great care should be taken to distinguish it "both in name and value from the secondary-school certificate." But this will be extremely difficult, and to give an alternative certificate of this kind will probably damage education in several ways. It will offer an inducement to a still larger number of pupils to leave secondary schools even earlier than they do at present. A not inconsiderable portion of the general public may very well think that a "testamur," which is a word less known to them than "certificate," is a thing of at least as great value; for to them *omne ignotum pro magnifico est*. There would be less objection to the proposed testamur if and when the certificate was given at the age of about eighteen, for there would then be a sufficiently wide gap between the standards to prevent the possibility of confusion.

The committee's suggestions in regard to the examinations council are, however, the most important. This council is to be of a representative character, including not only persons of educational experience, but also some with a knowledge of what is wanted by recruits for the professions, commerce, or industrial life. On the educational side there would be representatives of the Board of Education, the universities, the local authorities, and teachers in different kinds of schools.

The council would be entrusted with the important duty of regulating external examinations in secondary schools aided by the Board of Education, and would derive its power from the fact that no such school would be allowed to enter its pupils for external examinations other than those which the council conducted or approved. The inspectors of the Board of Education would place their experience at the disposal of the examinations council, so that the work of examination and inspection might be properly co-ordinated.

There can be little doubt that the formation of such a council would be of the greatest possible service, provided, of course, Parliament gave it sufficient authority to ensure that its decisions were respected. But the committee thinks that as a preliminary step the existing examining bodies might be asked by the Board of Education to confer together in order to see whether, by mutual consent, steps can be taken to bring about the state of affairs which the committee desires. It is very doubtful whether such a conference would meet with any considerable measure of success, though it is just possible that if, before convening the conference, the Board of Education made it evident that the existing examination swamp must be cleared, the examining bodies might find it expedient to agree to an amalgamation. For some of the vested interests could be considered; the majority of the existing examiners would probably be still employed, and even the officials and clerical staffs might be taken over by the new examinations council.

The committee wisely advises that, if the proposed conference be held, and it is found that those concerned will not voluntarily agree to modifications of the present system on the lines indicated, the Board should not consider itself to be relieved of responsibility, but should proceed to the formation of a representative examinations council with the powers mentioned above.

All the members of the committee signed the report with the single exception of Mr. Jackman, who objects to the proposals mainly on the ground that pupils in elementary schools will not be able to obtain the secondary-school certificate, and may, therefore, find their path to promotion barred. Some years ago this argument would have had considerable weight, for the "free place" system had not then come into being. Now, however, many pupils of the secondary schools come from the elementary schools, and it may fairly be said that in a large part of the country no bright child in an elementary school is precluded by poverty from the advantages of secondary education. If it be alleged that there are other parts of the kingdom where such exclusion takes place, then, surely, it would be better to take steps to modify this state of affairs rather than to block a most important reform affecting not merely secondary but also higher education. It is to be hoped, therefore, that the majority of teachers in elementary schools will not oppose the proposals set forth in the report of the committee, which bears the signature of Mr. Sharples, a respected member of their profession, who would not support any system likely to injure either elementary schools or their pupils.

J. WERTHEIMER.

THE PRISM-BINOCULAR.

ONE of the many revolutions which have been quietly proceeding in the last few years has been the introduction of the prism-binocular in place of the old form of opera- or field-glass. In 1851 an Italian, Ignatius Porro, devised a very ingenious and yet simple arrangement of prisms by which the simple astronomical telescope might yield an erect image. An instrument was constructed with these prisms by Boulanger, in 1859, and again in 1875 by Nachet, the firm so well known in connection with the binocular microscope. Neither of those makers succeeded in making it popular, however, probably partly because of the quality of the glass of which the prisms were made, and partly because the prisms were not well enough worked to give good images—the light is four times reflected, and it is obvious that if the reflecting faces are not all perfectly flat the definition will be seriously impaired. In 1893 Ernst Abbe designed an instrument, making use of the new glass obtained by Schott; the resulting "prism-binoculars" made under the modern conditions were an immediate success. The faces of the prisms are tested by Newton's bands of colour. These bands must be perfectly straight right up to the edge. The refracting surfaces are tested, as well as the reflecting, though perfection of the latter is the more important.

The advantages of the new form of opera-glass over the old are the great field of view and depth of focus, with a higher power. The image is not quite so bright, and therefore for night work the old form is best. In the old form, the field of view depends on the diameter of the objective as imaged by the eye-lens, and with even a moderate power the diameter has to be large; thus the glasses are clumsy. In the new form the field is independent of the diameter of the objective, and when there is plenty of light the latter can be made quite small.

The new glasses are made by several firms, and we have recently had the pleasure of inspecting some of the models made by the firm of Leitz, with magnifications ranging from four diameters upwards. The chief feature which their glasses possess over others, we have seen, is their lightness, due to the construction of the bodies of nickel-steel tubes, which